EFFECT OF SPECIMEN SIZE AND SHAPE ON COMPRESSIVE STRENGTH OF FOAMED CONCRETE CONTAINING KENAF FIBER

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor Degree of Civil Engineering.

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Kajian terdahulu mengkaji kesan saiz dan bentuk spesimen pada kekuatan mampatan konkrit berbuih. Terdapat dua campuran konkrit berbuih (FC) dan konkrit berbuih yang mengandungi gentian kenaf (KFC). Semua spesimen telah diuji untuk menentukan kekuatan mampatan dan kebolehkerjaan konkrit berbuih. Saiz dan bentuk spesimen yang digunakan untuk kekuatan mampatan ialah kiub saiz 150 x 150 x 150 mm, 100 x 100 x 100 mm dan 50 x 50 x 50 mm dan silinder 150 x 300 mm dan 100 x 200 mm. Ketumpatan campuran direka sebagai 1600 kg / m^3. Dari hasil eksperimen, kedua-dua campuran menunjukkan peningkatan dalam kekuatan mampatan untuk semua saiz dan bentuk spesimen bentuk 7 hari hingga 28 hari. Berbanding dengan campuran FC, campuran KFC menjana kekuatan mampatan yang lebih tinggi kira-kira 12 MPa dalam saiz kiub 150mm x 150mm x150mm pada 28 hari dan mencapai 10 MPa dan 28 hari dalam saiz silinder 150mm x300mm.

ABSTRACT

Present research studies the effects of specimen size and shape on compressive strength of foamed concrete. There are two mixtures of foamed concrete (FC) and foamed concrete containing kenaf fiber (KFC). All specimens were tested to determine the compressive strength and workability of foamed concrete. The size and shape of specimens used for compressive strength were cubes of size 150 x 150 x 150 mm, 100 x 100 x 100 mm and 50 x 50 x 50 mm and cylinders of 150 x 300 mm and 100 x 200 mm. The mix density was design as 1600 kg/m^3. From the experimental results, both mixtures showed increases in the compressive strength for all sizes and shape of specimens form 7 days to 28 days. As compared to FC mix, the KFC mix generate higher compressive strength about 12 MPa in cube size 150mm x 150mm x150mm at 28 day and achieved 10 MPa at 28 day in cylinders size 150mm x300mm.

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%	Percentage
σ	Strength
δ	Deflection

LIST OF ABBREVIATIONS

KFC	Foamed Concrete Containing Kenaf Fiber
FC	Foamed Concrete
KF	Kenaf Fiber
OPC	Ordinary Portland cement
ASTM	American Society for Testing and Materials
FKASA	Fakulti Kejuruteraan Awam dan Sumber Alam
UMP	Universiti Malaysia Pahang
w/c	Water-Cement ratio
s/c	Sand-Cement ratio
NaOH	Hydroxide Sodium
Kg/m^3	Kilogram per meter cube
MPa	Mega Pascal
mm	Millimetre
kN/m	kilo Newton per meter
kPa	kilo Pascal

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Foamed concrete is a lightweight concrete with lower density where it achieved through an elimination of coarse aggregate from the concrete. In addition, density of formed concrete ranged within 300 kg/m^3 up to 1800 kg/m^3 which the usage of lightweight concrete is significantly reduce the dead load of building physically, that in turn cause the decreasing of beam and column size which may cut the cost of the project. Hence, foamed concrete can be considered as the alternative to reduce the cement content, aggregates and environmental problem. Foamed concrete widely used in construction industry as insulation for non-structural application where it is containing air voids produced by adding foaming agents, where these agent creating pores within the concrete without any additional reaction between the chemical and the cement and it has been characterized by its low compressive strength and high insulation against heat and sound (Rudnai G., 2003).

For foamed concrete with cast density of 1440kg/m^3 or above, water reducing admixtures may be used to reduce the water to cement ratio in the mix and hence increase the compressive strength. According to (Siram KKB, 2013), studying foamed concrete and present generation's building solution had concluded that foamed concrete, having gained importance because of its wide range of applications which include thermal insulation, Fire resistance, Chemical resistance, Workability, Flow-ability, Sound absorption, Self-compacting, Density and Energy adsorption which become the problem solver for wide variety of challenges in construction, mining and

manufacturing applications.

A Kenaf fiber is a type of natural fiber and is an annual growing to 1.5-3.5 m tall with woody base. The stems are 1-2 cm diameter often but not always branched. (Wang, Lam & Ramil, 2011), also, is seen as a promising green material as it reused natural resources in the concrete. Furthermore, owning to the benefits of fiber's tensile properties, inclusions of kenaf fiber in concrete resulted in better flexural and shear strength and ductility of the reinforced concrete structure. However, to ensure good performance, kenaf fiber similar like other type of natural fibers need to undergo some treatment to reduce high water absorption characteristic of the fiber One of the treatments recommended found to use a chemical such as sodium hydroxide (NaOH) to reduce the hydrophobic characteristic of the fiber. Thus, enhancing the adhesion between the fiber surface and the matrix. This was done by removing the hydroxyl group in cellulose and increasing the surface roughness which resulted in the improvement of the tensile properties of kenaf fibers as compared to untreated kenaf fibers (Elsaid et al., 2011).

The mechanical property that focused in this scope of study was compressive strength. In theory, foamed concrete produced a different value of compressive strength due to different density. The value of compressive strength for density 1200 N/mm^2 4.5 to 5.5 N/mm^2 then, the value of compressive strength for density 1400 N/mm^2 was 6.0 to 8.0 N/mm^2 and density 1600 kg/m^3 the value of compressive strength was 7.5 to 10.0 N/mm^2 (Aldridge, 2000).

Presently, this research was to investigate the effect of specimen size and shape on compressive strength of foamed concrete containing kenaf fiber. There are 2 common types of compression test which are cube test and cylinder test. In this study, the cube and cylinder strength was analysed in order to determine the relationship between them. Nowadays, the concrete structures was designed according to BS 8110 and the compressive strength referred by cube strength. However, in a few years, the European Standard, Euro-code 2 (EC2) will be used to replace British Standard (BS 8110) and described by characteristic of cylinder strength.(M.A.S. Sudin 2011).

1.2 Problem Statement

Nowadays, rapid development in our country makes the excessive uses of Ordinary Portland Cement (OPC). OPC produces approximately one tone of carbon dioxide per tons produced (Mahachi J, Golinger A M & Wagenaar F, 2004), raising significant environmental concerns. As the OPC is not very much economical friendly, many researches have been done to replace the use of OPC, as an example the aggregate is replaced with foam. Thus, makes the concrete lighter. It is found that the compressive strength of foamed concrete is mainly influenced by density (E. P. Kearsley & H. F. Mostert, 2005). So, the size and shape of specimen becomes an important parameter for the compressive strength of foamed concrete (Sarıdemir,2013).

1.3 Objective of Study

The goal of this study was to investigate the effect of specimen size and shape on compressive strength of foamed concrete containing kenaf fiber. The specific objectives of this study are:

i. To study the effect of specimen size on compressive strength of foamed concrete.
ii. To study the effect of specimen shape on the compressive strength of foamed concrete.
iii. To determine the workability of foamed concrete by using flow table test.

REFERENCES

Abdullah, Mohd Mustafa Al Bakri et al. 2012. "Fly Ash-Based Geopolymer Lightweight Concrete Using Foaming Agent." *International Journal of Molecular Sciences* 13(12):7186–98.

Brocken, Harold and Timo G. Nijland. 2004. "White Efflorescence on Brick Masonry and Concrete Masonry Blocks, with Special Emphasis on Sulfate Efflorescence on Concrete Blocks." *Construction and Building Materials* 18(5):315–23.

Hamad, Ali Jihad. 2017. "Size and Shape Effect of Specimen on the Compressive Strength of HPLWFC Reinforced with Glass Fibres." *Journal of King Saud University - Engineering Sciences* 29(4):373–80. Retrieved (http://dx.doi.org/10.1016/j.jksues.2015.09.003).

Jignesh, Kerai. 2015. "Effect of Use of Silica Sand as Fine Material in Concrete." 2(1):266–71.

Kearsley, E. P. and P. J. Wainwright. 2001. "The Effect of High Fly Ash Content on the Compressive Strength of Foamed Concrete." *Cement and Concrete Research* 31(1):105–12.

Krishna, Rao, Rathish Kumar, and B. Srinivas. 2011. "Effect of Size and Shape of Specimen on Compressive Strength of Glass Fiber Reinforced Concrete (GFRC)." *Facta Universitatis - Series: Architecture and Civil Engineering* 9(1):1–9. Retrieved (http://www.doiserbia.nb.rs/Article.aspx?ID=0354-46051101001K).

Lcc. 2003. "HIGH-STRENGTH STRUCTURAL LIGHTWEIGHT CONCRETE A New Direction towards Advanced Construction Techniques Using High-Strength Lightweight Cellular Concrete in the Development of Concrete in Building and Civil Engineering Construction SPECIFIED DENSITY CONCRE."

M.A.S. Sudin, M.Ramli. 2011. "Effect of Specimen Shape and Size on Compressive Strength of Concrete." *Advanced Materials Research* 163–167:0–5.

Memon, Shazim Ali, Rao Arsalan, Sardar Khan, and Tommy Yiu Lo. 2012. "Utilization of Pakistani Bentonite as Partial Replacement of Cement in Concrete." *Construction and Building Materials* 30:237–42.

Narayanan, N. and K. Ramamurthy. 2000. "Structure and Properties of Aerated Concrete: A Review." *Cement and Concrete Composites* 22(5):321–29.

Saridemir, Mustafa. 2014. "Effect of Specimen Size and Shape on Compressive Strength of Concrete Containing Fly Ash: Application of Genetic Programming for Design." *Materials and Design* 56:297–304.

Syed Mohsin, S. M., A. O. Baarimah, and G. A. Jokhio. 2018. "Effect of Kenaf Fiber in Reinforced Concrete Slab." *IOP Conference Series: Materials Science and Engineering* 342(1).

Thakrele, M. H. 2014. "Experimental Study on Foam Concrete." *International Journal of Civil, Structural, Environmental and Infrastructure Engineering Research and Development*.

Tokyay, M. 1997. “Pp. 1281-1289.1997.” 27(8):1281–89.

J.E. Aubert, P. M. 2015. Towards a simple compressive strength test for earth bricks . *Materials and structures* , 1641-1654.

morel, J.-C. 2005. compressive strenght testing of compressed earth blocks . *ELSEVIER Construction and Building materials* , 303-309.

Siram KKB. Foam concrete – The present generation’s building solution. International Journal of Civil, Structural, Environmental and Infrastructure Engineering Research and Development (IJCSEIERD). ISSN:2249-6866. 2013;3(4):59-62

Kearsley, E. P. and P. J. Wainwright. 2001. “The Effect of High Fly Ash Content on the Compressive Strength of Foamed Concrete.” *Cement and Concrete Research* 31(1):105–12.

Indu Siva Ranjani, G. and K. Ramamurthy. 2012. “Behaviour of Foam Concrete under Sulphate Environments.” *Cement and Concrete Composites* 34(7):825–34. Retrieved (http://dx.doi.org/10.1016/j.cemconcomp.2012.03.007).

Amran, Y. H. Mugahed, Nima Farzadnia, and A. A. Abang Ali. 2015. “Properties and Applications of Foamed Concrete; A Review.” *Construction and Building Materials* 101:990–1005. Retrieved (http://dx.doi.org/10.1016/j.conbuildmat.2015.10.112).

Memon, Shazim Ali, Rao Arsalan, Sardar Khan, and Tommy Yiu Lo. 2012. “Utilization of Pakistani Bentonite as Partial Replacement of Cement in Concrete.” *Construction and Building Materials* 30:237–42.

Amran, Y. H. Mugahed, Nima Farzadnia, and A. A. Abang Ali. 2015. “Properties and Applications of Foamed Concrete; A Review.” *Construction and Building Materials* 101:990–1005. Retrieved (http://dx.doi.org/10.1016/j.conbuildmat.2015.10.112)